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ABSTRACT

This exploration of the potential for gender-role stereotypes to interfere with the constructive integration of computers into elementary and secondary school classrooms suggests that gender-related differences in perceptions of abilities in mathematics and science are the precursors of similar perceptions regarding computer use. Literature pertaining to the development of gender-role perceptions and the effects of these perceptions on self-image and achievement is examined, including studies concerning attribution theory, and the influence of context on learning is discussed. Methodological constraints in gender-role research are considered, including problems with prior research resulting from lack of adequate sampling during test construction, poorly defined constructs, simplistic and biased conceptual bases, instrument bias (even in newer scales), and lack of comparability across instruments. Directions for the conceptualization of new research are also described. A 29-item reference list is included. (Author/LMM)

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Preventing Gender-Role Stereotypes in Classroom Computer Use: The Importance of Creating the "Right Conditions"

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Paper to be presented at the Speech Communication Association Conference, Chicago, Illinois, November, 1984.

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Abstract

This paper explores the potential for gender-role stereotypes to interfere with the constructive integration of computers into elememtary and secondary school classrooms. Gender-related differences in perceptions of abilities in mathematics and science are suggested to be the precursors of similar perceptions regarding computer use. Literature pertaining to the development of gender-role perceptions and the effects of these perceptions on self-image and achievement is examined. The influence of context on learning is discussed. Mehtodological constraints in gender-role research and directions for the conceptualization of new research are also described.

Preventing Gender-Role Stereotyping in Classroom Computer Use:

The Importance of Creating the "Right Conditions"

One doesn't need to go into the schools to get a sense of the growing interest and importance of micro-computers in classroom curriculua. The blossoming relationship between computers and schoolchildren is gossiped about in all forms of mass communication from advertisements to the news. A television ad shows us a young man failing in college because he doesn't have computer skills; a variety of television and print media ads stress educational software packages for children. A recent Nova program described the wonders of LOGO, the computer language for children and Time magazine (May 3, 1982) recently made children and computers a cover story. Computer camps are a fast growing business as parents are enticed not to let their children waste a summer in frivolous play, but instead to use the time to get a head start on future schooling.

These are some of the more obvious artifacts of the funneling of new technologies into the classroom. Some of the less clear, and not so visible, consequences of use of computers by students will be discussed here. This paper will focus on the interaction between the use of micro-computers in classrooms and gender-related perceptions traditionally associated with the domains of mathematics and science. By examining this issue, some of the factors that can contribute to the development of gender-related expectations regarding computer use will be identified. The manner in which the computer is integrated into the classroom will be seen as a salient influence on students' self-perceptions, motivations and behaviors regarding computer use.

Unfortunately, because the issues surrounding the widespread inclusion

of computer programming in elementary and secondary schools are relatively new, there are few published empirical studies assessing the effects of classroom computers. This necessitates extrapolating and collating the results of a variety of studies that have a logical relationship to the topic of interest. Naturally, computers have been used in classrooms for a number of years. The teaching machines used to deliver programmed instruction sequences (e.g., Skinner, 1968) are an example. The focus of this paper, however, will be to examine the consequences of the introduction of computers into classrooms for the purposes of teaching programming skills that allow the actual use of the computer for activities ranging from problem solving to "Space Invaders." The literature that will be reviewed will include that related to global issues of gender-role research and literature related to the effects of expectations on self-image and performance.

As one of the major socializing institutions, the educational system plays a prominent role in teaching children cultural values and beliefs. The larger culture provides the rubric in which the educational sub-culture mediates societal norms in the acheivement of educational goals and requirements. This mediation is a dynamic process in which malleable cultural beliefs are contoured to fit changes occurring in all parts of the social system. Amarel (1983, p.3) touches on this when she describes the classroom as a "working social group" that develops its own style of functioning, norms, etc. within the constraints of "frame factors." The frame factors include all aspects of the educational experience from the physical properties of the classroom to the rules and expectations imposed by the educational system and society.

Changing Gender-Roles

Cultural beliefs about the proper roles of men and women have been experiencing pervasive and notable changes over the past twenty to thirty years. Women and men have become "liberated", both in their perceptions of themselves and in their perceptions of each other. The various branches of the women's movement have made social, economic and political equality between the sexes an undeniable part of our national agenda. Again, to use the media as a measure of the public visibility of issues, we are exposed to many "female firsts", e.g., first female mayor, first female Supreme Court judge, first female astronaut, etc. In the academic world, sociolinguists and linguists debate the use of the term "he" as a generic pronoun, and into our written and spoken language filters the more egalitarian and descriptive "he/she" and its variants (see Martyana, 1983). Scholars also document a shift in measured attitudes regarding traditional gender roles. Wirtenberg and Richardson (1983, p. 3) find "profound changes in all aspects of our society, from child care arrangements to flexible work hours and job-sharing, to changes in patterns of automobile and public transit use."

If all these changes have occurred, and in our modern society everyone "knows" gender-role stereotyping is "wrong", then why is it necessary to be concerned about the possibility of gender-role socialization regarding computer use? It is necessary because despite many real changes, evidence persists that things aren't always as equal as they seem. This evidence ranges from empirical to anecdotal. Peterson, Thomas and Heaps (1982) report that families are more likely to allocate a greater proportion of their resources to a male than a female child in regard to career goal achievement.

Based on a veriety of informal observations, Keisler, Sproull, and Eccles (1983) find a marked tendency for boys to dominate schools' computer resources.

According to Wirtenberg and Richardson (1983, p. 3), all the rapidly occurring social changes regarding gender roles may be producing an undesired effect: "the rapidity of the developments of the last decade has occassioned a backlash, or an attempt to return society to a version of the status quo ante." Although it is not clear that such an ominous trend is occurring, it does seem advisable to remain sensitive to the effects that the apparently uneasy equality of the sexes may be having on the ways in which we socialize our children.

The ambivalence surrounding attitudes toward traditional gender roles may be realted to what Tarvis (1973) has referred to as "unliberated liberals." She defines unliberated liberals as "persons who are supportive of more contemporary sex roles in the abstract as transmitted via attitudes, but are markedly traditional in their personal relationships" (p. 85). Tarvis' observations are illustrative of those made by Fishbein and Ajzen (1980) regarding the necessity to differentiate between global and specific attitudes. According to their work, the relationship between attitudes and behaviors is typically not measured reliably due to the failure to measure the belief system directly antecedent to a specific behavior. For example, a subject's response to an item referring to belief in equality of the sexes cannot be used to predict that person's reaction in a situation where his/her car is assigned to a mechanic who is female. In other words, beliefs in global ideals frequently co-exist with "contradictory" beliefs related to individual

instances of the global domain.

Another factor frequently cited to explain the variable acceptance of contemporary gender-related attitudes is socio-economic status (SES). According to Peterson, et al. (1982, p.648), it is generally believed that families in which both parents have high levels of education and income will have egalitarian gender-role attitudes. However, the 183 families from upper SES brackets who participated in their study exhibited very traditional gender-role attitudes in decision-making. Each family completed a simulation entitled "Career Planning Game" in which decisions had to be made regarding career choices for the children and allocation of limited family economic funds for educational or other relevant training. In the 98 cross-sex sibling families, male children were given advantages over female children 80% of the time. For example, following a family financial crisis, the male child was given funds for college, at the expense of the female child, leading to 69% of the males achieving their occupational goals, but only 43% of the females selecting a career as their primary goal achieving theirs'.

Peterson, et al. note an apparent influence of "tacit agreements" among family members. (p.656) They report only one daughter openly objecting to the preferential treatment given to her brother. Moreover, it was most typical for the sister to initiate the suggestion that favored the goals of her brother. The authors speculate that even though female children may be less traditional than their parents, they know "what they should do", and do not create discord when their needs are subjigated to their brother's. (p.656)

The relevance of the lack of validity of the assumption that traditional gender-role stereotypes are not typical in upper SES groups lies in the fact

that it is schools in such neighborhoods that are most likely to be able to sfford classroom computers. The evidence that SES is not a good predictor of gender-role attitudes indicates that we cannot assume that differential treatment of male and female children will not occur in regard to computer education. Furthermore, it underscores the notion that we cannot expect the perceived changes in social values related to the roles of men and women to insulate children from exposure to gender-related prejudices, and more importantly, from the development of gender-related perceptions based upon these prejudices.

Perhaps some of the persistence of gender stereotypes regarding mathematical abilities is due to the waxing and waning popularity of explanations based upon genetically determined differences in cognitive processing skills. Weitz (1977) provides an extensive discussion of the historical roots of these stereotypes. She critiques the available evidence concerning male superiority on a variety of tasks related to mathematical skills, particularly those requiring analytic thought. She reports that beginning in adolescence

> females tend to be field-dependent, i.e., unable to adjust for competing contextual inputs, and males tend to be field-independent, i.e., they score better on those tasks that involve separating one element from a field. Such differences, although small, have been interpreted as indicating the relative superiority of males in the "analytic" style of thought. (p99)

The key phrase for Wietz is "such differences, although small." She makes the argument that consistent, large (not merely statistically signifi-

cant) differences have never been documented, but these small differences have been widely relied upon to explain the apparently "male" trait of preference for science and math-related tasks and occupations. Weitz finds it difficult to cleanly identify cognitive differences on problem-solving inherent to the sexes. She cites evidence that cross-sex, not same-sex, correlations exist between parents and children in problem-solving abilities. While this is suggestive of such abilities being a recessive gene carried by the X chromosome, Weitz reports that the consensus among genetisists is that this gene could not transmit spatial ability by itself and that environment, not heredity plays the key role. For example, the differences on toys given to children, erector sets to boys, tea sets to girls, place in motion differential patterns of treatment and expectations that may later be manifested in differences in behaviors. She concludes, "The contribution of genetic and biological components to performance on spatial tasks and mathematical tests is uncertain, but the over-riding influence of socialization and societal constraints is incontrovertible" (p.103).

The differences measured between males and females in spatial-analytic tasks (and beliefs and knowledge about why they occur) have direct relevance for the use of computers. Kiesler, et al. (1983) discuss this dilemma in terms of software typically available for both computers and arcade games. They state that much of the software requires rapid judgments that are based on spatial relationships. In addition, much of the software decidedly fulfills stereotypical expectations of "male" interests. "The software sold for home computers offers an array of land battles, space wars, and other forms of destruction, as well as typically male sports" (p.43). The authors quote

psychologist, Mark Leper, who states, "One sees ... a variety of presumably educatioanl games that involve the same themes of war and violence that are so prevalent in video-arcade games, ani another large class of programs that involve largely male sports: baseball, basketball, and football" (p.43). The advent of games such as "Ms. Pac-Man" may signal an attempt to adjust for the biases in the software, but the auhhors view these attempts as far too infrequent.

Assuming, as Kiesler et al. do, that the first encounter with computer software will be in video arcades, girls may approach computer use in school with much more trepidation than will boys. Video game arcades tend to be dominated by males, and girls, having less of a chance to master video skills,, tend to do more poorly than boys in tests of these skills. Kiesler, et al. point out that the girls' deficiences seem to be attributable to lack of practice and interest in typical video game fare, not to lack of inherent skill. They report that girls can perform at least as well as boys on video games when given to opportunity to practice the necessary skills. Providing these opportunities, then, is an essential component to discouraging the development of gender-related stereotyeps regarding computer use.

Development of Gender-Role Perceptions

Providing these opportunties is important, but equally important is providing them from the beginning of the child's experience with classroom computers. Awareness of gender-identity as evident as early as 18 months of age (Ramage, Rotherman, and Robinson, 1982), and knowledge of gender-roles is consistently found in pre-school aged children (Albert and Porter, 1982). Carter andPeterson (1982) conducted interviews with children from Kinder-

couched within a larger one in which all age groups' responses tend to follow traditional stereotypes.

> Despite the age and sex differences found, there was a striking amount of agreement among the children studied concerning sex-role standards about the areas of achievement tapped. Artistic, social, and reading skills were viewed as the most feminine (and least masculine) areas, while athletic, spatial and mechanical, and arithemetic were considered the most masculine (and least feminine) areas. (p.257)

This study indicates that all children are aware of societal expectations, but these expectations become more firmly entrenched as children mature.

Stein and Smithells offer a plausible explanation for their findings, based on discussions with the respondents. There is an age-related shift in the criteria used to judge appropriateness of behaviors. The 12th graders report thinking in terms of what is most appropriate for adults, not for children. So, for example, competence in math skills is equally appropriate for boys and girls in school, but since these students expected that boys would take more advanced math classes in college (and do better in them) than girls, math skills were assigned a masculine rating. Essentially, the responses of these subjects reflect an increasing awareness and sensitivity regarding what will be expected of them in the "real world."

Although these studies were conducted 13 years apart, their results have a degree of continuity. Both studies document the accuracy with which children can articulate normative gender-realted expectations. The studies have

different purposes, Carter and Patterson being interested in using the concept of a cognitive domain of social conventions to explain the developmental pattern of knowledge about gender roles, while Stein and Smithells intend to document the direction [illegible] of the developmental pattern. The content of the normative expectations changed little between the two groups of children. A noteworthy element found in both studies is the children's development of an increasingly more sophisticated cognitive representation of society's expectations, and a predisposition (or at least a resignation) to accept much of these expectations. The remarks of the 12th graders in the Stein and Smithells study bear witness to this.

Carter and Patterson tapped more directly into the extent to which children understand the differences between natural laws and cultural rules. They demonstrate that children become increasingly more aware of these differences, perhaps leading to the conclusion that they are more "liberal" than the children in the older study. This may be true to a certain extent, but the capriciousness of gender-role expectations is also hinted at by the subjects in the older study. This did not shatter their belief in them. Knowledge of the arbitrary nature of social conventions does not make them any less salient or compelling for the child. Turiel (1977) notes that even though children are aware of the nature of social conventions, they are still perceived as rules that must be obeyed, either until the society accepts a modification in the rule or some strict moral law supercedes it. The increase in latitude of acceptable behaviors we see in Carter and Patterson's subjects reflects more a change in the rigidity of cultural stereotypes related to gender than their disappearence in children's belief systems.

Although social change cannot be ruled out as a factor in the apparent increase in liberalness in children in the more current study, they know that gender-related expectations exist. If Turiel (1977) and Carter and Patterson (1982) are correct, then the pressure to conform to social conventions is strongly felt by all children. Ramage, et al. (1982, p.70) state that children's "social sex-role definitions are often couched in feelings and beliefs about 'normalcy'. It would seem that a careful construction of experiences with classroom computers could encourage children to "see" that the rules have changed, and their interests and goals may move beyond traditional restrictions.

Attributions and Achievement

The importance of a well-planned integration of computers into the classroom is evident in the effects that self-concept can have on acheivement goals and scholastic performance. Crandall (1969) notes that belief in the ability to succeed is directly related to academic competence in a manner analogous to the more general relationship between self-concept and competence. She also describes a positive relationship between expectancy of success and approach behaviors toward the tasks necessary to acheive that goal. This may be an intuitively obvious research result, but it does provide a starting point for examining the problems that may occur for female students in our culture, whose estimates of their academic performance in math and sciences are typically lower than those of their male peers.

Crandall constructed a series of novel tasks and compared the expectancy estimates that children (17 male, 24 female, aged 7 to 12 years) made regarding thier chances of successfully completing the tasks. Novel tasks,

for example, solving "brain-teasers, puzzles, recall of objects, were selected, according to Crandall, to eliminate the possibility that specific past experiences or performances would be a factor. The researcher hypothesizes that expectations would be lower for girls than for boys across all tasks, but that the abilities of the children would not significantly differ. Her hypotheses were confirmed. However, apparently the children did not actually complete the tasks, as Crandall uses only IQ as a measure of ability. Her results were obtained by comparing IQ scores relative to expectancy scores. She concludes that despite similar IQ scores between the groups the boys were significantly more likely to predict success, even at the most difficult task levels.

To explain these differences Crandall interviewed the children to determine their tendencies to give socially acceptable responses, and the amount of importance they placed on doing well in academic tasks. The fromer procedure was constructed to address the issue that females in our society are expected to be modest and not boast about expected or actual achievements, while this behavior is more tolerable in males. The latter was used to assess the impact of motivation on responses. Crandall reports no significant tendencies for the children to provide socially acceptable responses or to differ in their desire to do well in academics. She also reports no significant differences between the groups in past academic performance. She postulates that differences in self-concept based upon differential interpretation of similar educational experiences is most likely to account for the differing expectations of success.

She elaborates on this conclusion by reporting the results of other

studies she conducted with college students. When comparing expectations with actual performance, Crandall again finds that females tend to underestimate, while males tend to overestimate their performance. However, when female students were provided with high degrees of direct positive reinforcement for work in their courses, their predictions of the likelihood of future academic successes was significantly increased.

Crandall raises some interesting points; the tenor of her fingings will be seen in studies discussed later in this paper. Yet, her studies do not provide extremely compelling evidence. The study with the children has two serious flaws, the "novelty" of the tasks is questionable, and as the children do not actually complete the tasks comparisons between expectancy and ability are tenuous. Although the children may never have had experience with the specific tasks selected by Crandall, it is highly likely that they would have had very similar experiences. For example, the test of "numerical skill" involved a series of increasingly more difficult math problems that were to be worked out in one's head; the test for "spatial relations" involved a series of jigsaw puzzles. These activities are not sufficient for controlling for the influences of past experiences. It is very probable that the children used their perceptions of past experience with similar tasks to predict success on Crandall's tasks, not necessarily the global past experiences with math that Crandall suggests they use. The design of the study only allows for speculative discussions about abilities, furthering weakening Crandall's stance. The studies with the college students are an improvement, but they are not the focus of Crandall's article.

Crandall is correct in attempting to take into account theeffects of so-

socially acceptable responses in the form of differing self-presentation straegies. Self-presentation strategies are difficult to control for, but identifying them is a necessity in gender-role research. Understanding them will provide vital clues not only to the processes used to predict future performance, but also to the related processes used to account for degrees of success or failure on current tasks.

Recent work in attribution theory has highlighted the importance of the type of attributions made to account for success and failure (e.g., Janoff-Bulman, 1979; Jones & Berglas, 1978). Traditionally, attributions are described as falling along two dimensions, internal-external and stable-unstable. The first dimension focuses on locus of control, while the second focuses on ability to control outcomes and/or situations. Ability is an internal-stable trait as it is an intrinsic quality that remains essentially beyond our control to change, e.g., level of intelligence. This can be contrasted with "effort", which is a personal attribute that is controllable, i.e., we can always try harder, effort is therefore an internal-unstable trait. The external traits, task difficulity (external-stable) and luck (external-unstable), typically complete the typology (see Guttenberg and Longfellow, 1977, pp. 314-318).

According to Janoff-Bulman (1979) it is the degree of stability of internal traits, especially as perceived in terms of control, that make attributional processes powerful determinants of self-perceptions and behaviors. For example, if we perceive that an event occurred as the result of ability, we are likely to conclude that a similar outcome will occur in future instances of that event. However, if an outcome can be attributed to a "controllable"

trait, e.g., effort, we can present ourselves with the option of changing future outcomes by altering our behavior. In an analogous manner, external dimensions are outside of our control. Attributions based on these factors encourage a world-view in which the individual has little control over his/her life, contributing to low self-esteem and learned helplessness.

Dweck (1975) vividly demonstrates the effects of varying attribution strategies by linking the phenomenon of learned helplessness with the tendency to attribute failure to lack of ability. By training children (5 males, 7 females, aged 8-10 years) to attribute failures to lack of effort, Dweck was able to significantly increase the subjects' persistence to complete a task in which they had experienced prior failure. Dweck is not reccomending that excessive failures be built into an instructional situation, but rather "that errors should be capitalized upon as vehicles for teaching the child how to handle failure" (p.684).

The findings related to the effects of attributional strategies also indicate differential reliance on strategies, based on gender. Females are most likely to attribute success to external factors, such as luck, and to attribute failure to lack of ability. Males tend to attribute success to either ability or effort, but attribute failure to lack of effort. Females put themselves into a double bind in which success happens by chance because they see lack of intrinsic ability as the cause of their failures. Males' outlook on the future is likely to be more optimistic, as their failures can be overcome if they choose to try harder. The attribution literature identifies the patterns of self-presentation strategies found in gender research, but still does not answer the question of the degree to which these strategies are reflections

of the effects of cultural norms on self-disclosure or accurate representations of the beliefs of males and females. A more thorough understanding of the attributional process is an essential direction for future research in gender-role development.

Guttentag and Longfellow (1977) assess the consequences of attribution strategies used by students in the process of social comparison. They describe developmental trends in attribution strategies and provide additional evidence of gender differences in preferred strategies. The authors note that social comparison is an important element in self-evaluation as early as age five. By the time a child is eight years old he/she is routinely using a variety of attributions to assess the outcomes of their own and others' behaviors. The relationship between attribution strategies and expectations for success noted above appears to be viable at a very early age, compounded by gender-specific trends. The authors report some evidence that the relationship is apparent in kindergarten, but state that "once children enter school, fairly consistent patterns of achievement expectations and achievement attributions are established which differentiate males from females" (p.322). The typically low estimates of females (when compared to males) of current and future performance co-exist with relatively equal performance between the sexes.

The authors state that this phenomenon is likely to be due to the development of gender-role identity coupled with differential socialization. They correctly point out that the effects of situational factors must be taken into account in any explanation of the attribution process. There is a tendency to provide different attributions for the same behavior depending upon the characteristics of the observer and the situation. Elementary school girls are most likely to attribute failure to lack of ability and to give up try-

ing to complete a task when the evaluator is a female adult, and most likely to attribute failure to lack of effort when the evaluator is a peer or male adult. For boys, ability attributions are most likely to be made for peer evaluators, while effort attributions are most likely to be made for an adult evaluator of either sex. Jacklin (1983) confirms Guttentag and Longfellow's interpretation of the literature regarding the effects of sex of evaluator on attributions. In summarizing the findings, Guttentag and Longfellow state:

> The implications for American classrooms is clear: feedback from a female teacher has a negative deteriorating effect on girls' academic performance, while it seems to spur the boys onward. (pp.322-323)

Guttentag and Longfellow also report the results of observational studies of elementary school classrooms that indicate differential patterns of teacher to student feedback, dependent upon the sex of the student. Feedback to boys regarding incorrect schoolwork was related to intellectual quality of the work about 50% of the time, with the remaining generally referring to lack of effort on the part of the student. For girls, 80% of the feedback directly related to intellectual quality, and 20% to other causes such as lack of effort. Because past performance and experiences are used to develop self-image and future expectations, the consequence of such feedback patterns is likely to be the encouragement of learned helplessness in female students. As the authors note, there is initial evidence that children may be more likely to attribute school performance to internal than to external causes. "Because attribution of achievement outcomes to internal causes is known to be strongly related to feelings of pride and shame (Weiner, et al., 1971), it appears that the academic setting has a powerful impact on the child's self-esteem" (p.318).

Guttentag and Longfellow do not suggest that these problems are of a hopeless magnitude. They describe an intervention strategy experimentally introduced into a school system by the first author. The program was designed to foster awareness of gender-role stereotypes in students and teachers. Classes of kindergarteners, fifth and ninth graders (Total N = 409) were assigned to experimental (14 classes) or control conditions (five classes). The program consisted of the development of non-sexist curricular materials by teachers and the researcher during a series of workshops prior to the classroom intervention. During the six weeks of the classroom program the teachers in the experimental groups integrated their choice of the materials provided into their classroom agenda.

Pre- and post-intervention tests were adminsterred to the students, including projective picture tests in which the children created stories about the man or woman in a picture and a variety of measures in which children's notions about typical personality traits, occupations and activities of males and female adults and children were obtained. In addition, classroom observations were made of teacher-student interactions.

Prior to the intervention, all age groups included gender stereotypes in their responses to the researcher's measures. There was a positive correlation between age and the degree of "overlap" in the perceived appropriateness of roles, e.g., the kindergarteners tended to see occupations as either "male" or "female" while the ninth graders were significantly more likely to respond that either a man or a woman could have a specific job. Also, prior to intervention all children displayed an interesting tendency to attribute strongly stereotypic traits to others and more androgynous traits to themselves.

This occurred regardless of the sex of the target or the subject, or how well the subject knew the target, for example, family roles were described in high-stereotypical terms. Theresearchers speculate that this tendency has its roots in the proclivity of humans to make dispositional attributions to others while seeing themselves as behaving in variable fashions, depending upon situational contexts.

Generally the intervention had a positive, if rather uneven effect. The experimental groups' post-test scores were significantly different from the controls', and were most often significantly different from their own pre-test scores. The researcher reports that girls in all experimental classes showed a greater experimental effect than did their male classmates. Other results were more grade-specific. The kindergarteners significantly decreased the rigidness of their gender-role stereotypes. The fifth graders, who as a group initially tended to ascribe to the belief that men and women should be treated equally but held "sublte male-female distinctions" (p.330), e.g., men as strong, women as nuturant, showed little change. In the ninth graders a backlash occurred among the boys, who became decidedly more traditional, while the girls showed the largest shift in awareness of the negative consequences of stereotyping. Guttentag and Longfellow state:

> Perhaps the boys were unconsciously more hesitant to support the equalization of roles because they felt themselves currently in the position of power and may have believed they had more to lose in prestige. Men, the boys believed, are tightly geared toward vocations and monetary success, a context in which competition rather than cooperation is valued. (p. 332)

The authors rely heavily on the variation in classroom contexts to explain the disparate effects of the intervention strategy. Indeed, as the teachers had control over which of the instructional materials they would use in the classroom, the "experimental stimulus" was not identical across "experimental groups." The authors also report a range of reactions to the use of the instructional materials from extreme resistance to extreme enthusiasm. No teacher was forced to take part in the study, but some were more motivated than others, leading to variations in the effects of the intervention. This was most clearly seen in a ninth grade class in which the teacher is described as "the most active and enthusiastic ... in the study" (p.332). This class exhibited the greatest effect of the intervention program.

Other situational variants that may have influenced the outcomes are peer pressure and class structure. Peer pressure may account for the negative results noted in the ninth grade boys' responses. Observational data reveal that in peer group discussions, the boys were more likely to denigrate than support the intervention process. Classes that were structured in a non-traditional manner tended to produce the desried effect more often than traditionally structured classes. However, there was no consistent change, regardless of class structure, in the bias of interaction patterns favoring males. The classroom observations show that following intervention, boys were no less likely to answer questions and provide spontaneous comments more freqently than the girls in their class. In addition, teachers were no less likely to discourage monopolization of class discussion by male students.

Guttentag and Longfellow raise a number of salient concerns that blend with notions expressed earlier in this paper regarding the danger of expecting

the increased acceptance of less rigid gender stereotypes will "automatically" be applied to the integration of computers into the classroom. Kiesler, et al. (1983), provide a preliminary scenario, based on classroom observations:

> In one Michigan preschool, the boys created a computer club and refused to let the girls have access to the equipment. In each case when a teacher intervened and set up time-sharing rules, the girls spent as much time in the computer as the boys. Apparently, the girls like to use the computer, but not if they have to fight with the boys to get a turn. (p.48)

These observation represent the worst and the best of possibilities. The interactions follow the template of male domination of classroom time and resources, and female deference. An encouraging signal is that some teachers intervened, with positive consequences from the intervention. Despite the anecdotal nature of these observations, they are useful in illustrating that careful structuring of computing curricula is necessary. The domination of a tangible resource, computers, is much more easily recognized than is the domination of a less tangible resource, opportunity for student responses in a classroom. This may "stack the deck" in favor of controlling biases in the use of computers in the classroom. The danger does seem to exist that unequal participation may be initially mis-read. It may seem plausible to a school that boys are more likely to be interested in computers, and a lack of computer use by girls could be used as corraboration of this belief. In order to avoid allowing computers to fit "too well" into the classroom interaction routines that appear to exist, it is necessary that the factors underlying gender based differences in interaction styles and academic interests be clearly

delinated. It is equally stereotypical to assume that all boys want to be "hackers" as it is to assume that girls are afraid to be. Careful planning must be a part of all phases of a school's development of its classroom computer capabilities. An increased sensitivity to the potential for gender-based biases is an excellent starting point.

The contradictory nature of the published research may be an indication that the social changes of the past few decades are making children as well as adults more aware of the stereotypes we hold. Parsons, Adler, & Kaczala (1982), for example, find that parents in high SES brackets ascribe more importance to math and science courses for their sons than their daughters, and believe that their sons have essentially an innate ability for these courses that their daughters do not possess. Parsons, et al. hypothesize that the differential expectations and attributions of these parents is related to the distorted pictures their children have about their math abilities and their plans for the future. Girls in this study were much more likely than boys to underestimate their actual performance in math courses and to report plans to avoid future math and science courses and/or careers in those fields.

Paulsen and Johnson (1983) and Nemerowicz (1979) see signs of change. Paulsen and Johnson report that there were no significant differences between boys and girls in attitudes toward math. Both groups (equal numbers of males and females from fourth, eigth and eleventh grades, N=317) had positive attitudes toward math as an academic subject and believed that success in math and related fields was equally appropriate for males and females. The girls in this sample had not excluded the possibility of taking advanced math courses or pursuing careers that involved math and science. The boys did not display the strong tendency to hold onto traditional stereotypes noted in earlier

studies.

Nemerowicz (1979) also finds evidence of a lessening of the beliefs in gender-role stereotypes. She reports that the second, fourth, and sixth graders from lower-middle to middle class families whom she interviewed were developing less strict gender-role perceptions. The older children were least likely to hold stereotypic beliefs regarding the intrinsic qualities of males and females and to view occupations as appropriate only for one gender. Nemerowicz's observations regarding the children's responses provide a summary of much of the research discussed so far:

> The second graders in our sample have had not had as much exposure to the ideology of gender equality. Much of the old ideologyof sex stratification still dominates society and is reflected in the perceptions of the younger children. Even so, it is likely that ...they will become more liberal in their perceptions because the structural changes will become more pronounced and the children will also have more experience with the changes. (p.171)

Methodological Concerns

Nemerowicz touches upon an issue that is central to dealing with gender-role research: social change. Sherif (1980, p.8) cogently argues for researchers to become more attuned to the need to construct research sensitive to the process of social change. Beere (1979) provides a thorough critique of gender-role measures in use for the past 40 years. She finds little to like in measures used for children or adults, but notes changes in the content of measures since the early 1970's. Prior to 1970, scales commonly in use,

for example, Gough Femininity Scale, M/F scale of the Minnesota Multi-Phasic Inventory, were based on constructs of masculinity and femininity treated as bi-polar ends of a single continuum. In addition to the methodological problems resulting from lack of adequate sampling during test construction and poorly defined constructs, the conceptual bases for these instruments was both simplistic and biased. The scales did not permit a single respondent to score highly on "masculine" and "feminine" traits. These constructs were deifned in suspect and highly stereotypical fashions, e.g., the Gough scale con ains the item, "Sometimes I feel I'm about to go to pieces.", which purports to identify a "feminine" trait. (p.117) As Beere correctly observes, this item more clearly measures neuroticism than femininity.

Measures used widely since the 1970's typically treat the constructs of masculinity and femininity as falling along separate continua, e.g., Bem Sex Role Inventory (BSRI), Personal Attitude Questionnaire. A consequence of this shift has been the inclusion of the construct of androgyny. Although Beere agrees that a more complex conceptualization of gender-roles is needed, this latter construct has not been adequately defined and its use has not resulted in refinement of theoretical notions regarding masculinity and femininity. While there may be a consensus that an androgynous person is one who scores highly on "masculine" and feminine" items, no consensus exists on what constitutes reliable items.

The newer scales are not bias-free, but rather have changed their direction of bias. The majority of items describe only positive traits typically associated with either sex. This leads to several problems, most obviously the impossibility of tapping into all salient aspects of the domain. Beere also links this trend to an increased chance of social desirability biasing

A consistent problem with gender-role measures is lack of comparability across instruments. This occurs, according to Beere, because of a lack of consistency and/or explicitness in the definitions of constructs, and as a result of the volitale nature of normative beliefs regarding gender-roles. Measures tend to mix the concepts of "typical" and "ideal" gender-roles. (p.130) Subjects' responses may therefore appear to reflect belief in stereotypes, when in fact the responses may be derived from accurate portrayls of the world. Beere calls for clarification in our measures so that the differences between descriptive and prescriptive traits are obvious to both subjects and researchers. Beere believes the measures currently in use may be contibuting to the perpetuation of the stereotypes they are used to assess because of the continued reliance on gender stereotypes in their items. She concludes, "Social science researchers might consider replacing sex role scales with measures of other variables, such as personality attributes, which can be defined across groups and across time" (p.127).

Conclusion

The methodological short-comings of research on gender stereotypes indicate more than the improvement of the methodology. Despite a muddled sense of whether children's responses reflect prescription or decsription, gender-related are part of how they view the world and their place in it. Carter and Patterson's (1982) work indicates that children's notions regarding gender-roles fall within the domain of social conventions, suggesting that as these notions develop they are dis-associated with "laws of nature" and subject to change based on experiences in the social milieu. The manner in which children are familiarized with classroom computers can have a profound impact on

how they view personal and societal expectations regarding computer use. This effect could be easily generalized to related areas of math and science.

Despite the potential ramifications of classroom computers for gender-related stereotypes, relatively little is available that deals with it. For example, Chafin, Maxwell, & Thompson (1982) and the report of the proceedings of the conference of the Association for the Development of Computer-Based Instructional Systems (1980) focus on classroom computer use, but avoid the issue of the social impact on children's gender perceptions. This apparent lack of interest may be due to a belief that sufficient social change has occurred, so that gender biases are no longer a problem. Martyna (1983) finds a parallel between William James' observations on the movement of new ideas through society and current attitudes regarding the need for continued concern about gender stereotypes. Ideas follow three stages:

> It is first attacked as absurd; then admitted to be true, but seen as obvious and insignificant; and finally, seen as so important that its adversaries claim they discovered it. (p.27)

Perhaps belief in the need for research to facilitate constructive experiences with classroom computers falls within the second stage, stereotypes may still be "hanging around" but they are weak and sure to vanish and therefore of no social consequence.

The recency with which computers and their barrage of attendant software have become avialable to schools naturally contributes to a lack of research. Those who do discuss the social consequences of classroom computers seem to overlook some important points. Pappert (1980) discusses a general, societal

apprehension regarding partaking in mathematical and scientific activities as a barrier to productive use of classroom computers. He states that "all children will, under the right conditions, acquire a proficiency with programming that will make it one of their more advanced intellectual accomplishments" (p. 17). Certainly the ingenuity of "Turtle Geometry" and LOGO programming language will contribute to the "right conditions." However, if we accept his contention of cultural "mathphobia", then it is logical that this "phobia" will be even more problematic for girls who have been historically encouraged by their culture to devalue overcoming it.

Amarel (1983) also focuses on the importance of the classroom environment. She introduces the notion that the social consequences of the classroom computer have been ignored in favor of study of computer hardware and sortware.

> The relationship between instructional events and students' cognitive activities that mediate learning is not well enough understood to guide teachers' decisions, nor are the effects of different classroom organizations sufficiently clear to determine the design of the settings. Yet developments of pedigocially sound and classroom-friendly computer instruction is contingent upon such understandings- the technology, per se, does not benefit education. (p.17)

Amarel reports that initial research indicates the teacher is the "most powerful influence" in the manner in which a computer is introduced into the

classroom. (p.21) This is pertinent to Kiesler, et al.'s (1983) observations of the effects of teacher intervention in allocating computer use. It also accentuates the results reported by Guttentag and Longfellow (1977) which raise the possibility of sublte gender-stereotyping in teacher-student interaction. Although Amarel finds that the "lesser involvement of girls with instructional technology has been noted frequently" (p. 24), she is hesitant to provide any discussion of the underlying dynamics that may contribute to this pattern. She does touch upon one trend which she believes will create a non-productive atmoshpere for classroom computer use. She advises teachers to resist the forces that are currently operating to relegate them to the positions of "educational functionaries" (p. 25), carrying out the curricula, instructional objectives and assessment methods handed down from school administrations. Amarel views increased administration control as resulting in a de-emphasis on reacting to the indivivualistic qualities of students. This implies the existence of classroom environments that will encourage reliance on normative expectations, i.e., stereotypes, in teacher-student relationships.

Amarel encourages teachers to develop an awareness of the personal qualities of their students. This is excellent advice, but there appears to be little available for teachers interested in creating an atmosphere in which they can realistically control for gender-stereotypes relating to computer use. In this paper an attempt has been made to begin to point out the factors relevant to informed research on the interaction of gender-role stereotypes and the use of classroom computers. The issues are complex. Research must take into account the developmental nature and cognitive structuring of gender-related beliefs. Communication patterns among students, teachers and students, in addition to the language of textbooks and software should be examined

for the occurrence of characteristics likely to perpetuate stereotypes. The relationship of attribution strategies to the development of gender-role perceptions is another area of importance. These strategies seem highly related to the expectations and behaviors that develop in a variety of contexts. Research showing the effects of attributions on students' perceptions of math and science provide a base form which to work.

Many of the barriers related to the research being proposed are methodological. Jacklin's (1983) list of ten methodological concerns pertinent to gender research is both succint and comprehensive. For example, "confusion of within-sex with between-sex differences" and "failure to distinguish the significance of an effect from the size of an effect" are particularly relevant. (p.93) Beere (1983, p.133) states, "Perhaps it is time to slow the collection of data pertaining to gender-related issues, to concentrate instead on the development of adequate measures." This point is well-taken, especially when a new area of research is opening, incentives increase to avoid mistakes of the past. Prudent research will help us to avoid more than the methodological mistakes of the past, but also the cultural mistakes that encouraged children to view themselves and others in terms of gender-related stereotypes.

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